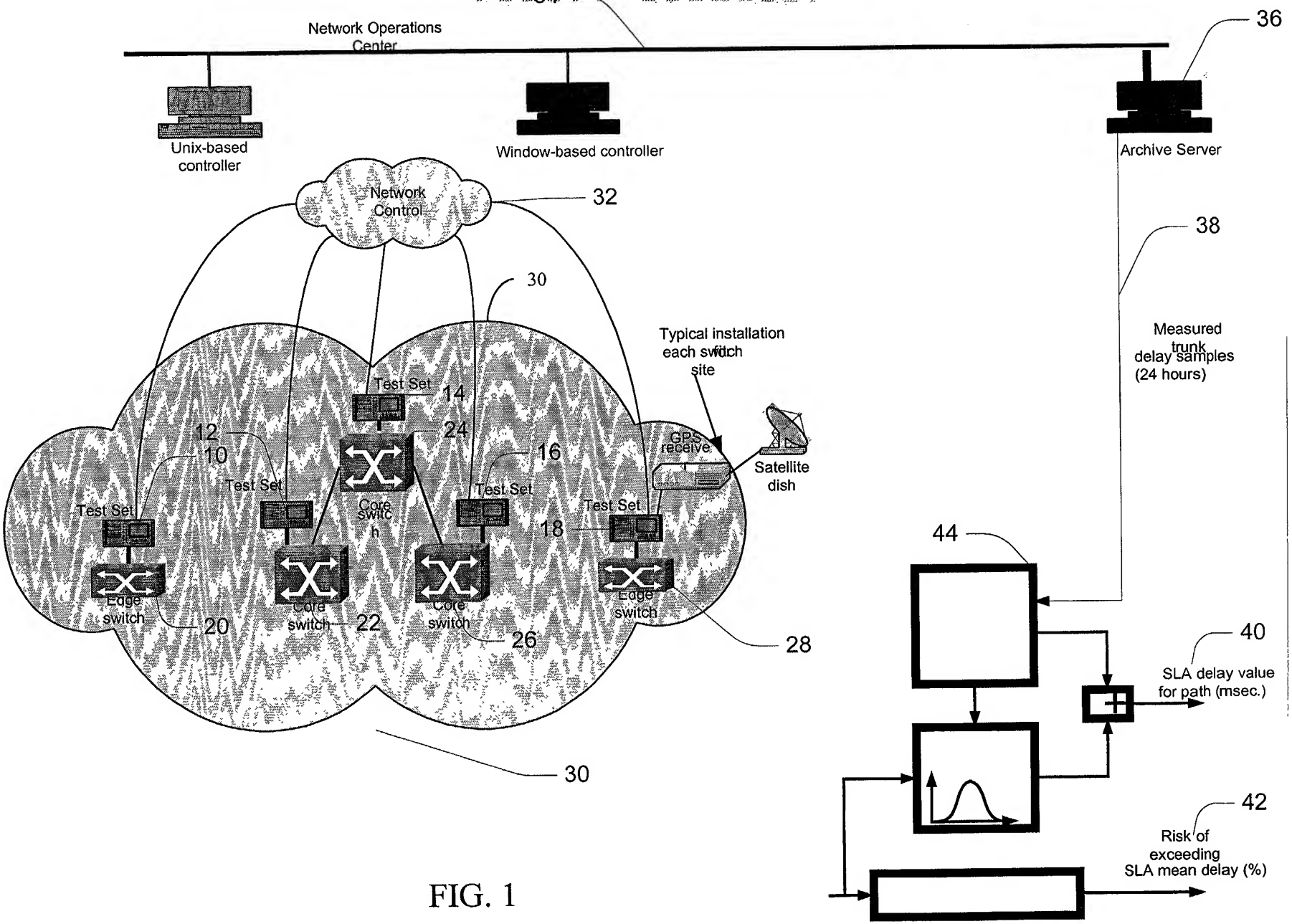

FIG. 1

Attorney: Frank L. Cire
Docket No.: 47240/FLC/I281
Inventor(s): Shlomo Varsano
Title: METHOD AND APPARATUS FOR AUTOMATED SERVICE LEVEL AGREEMENTS
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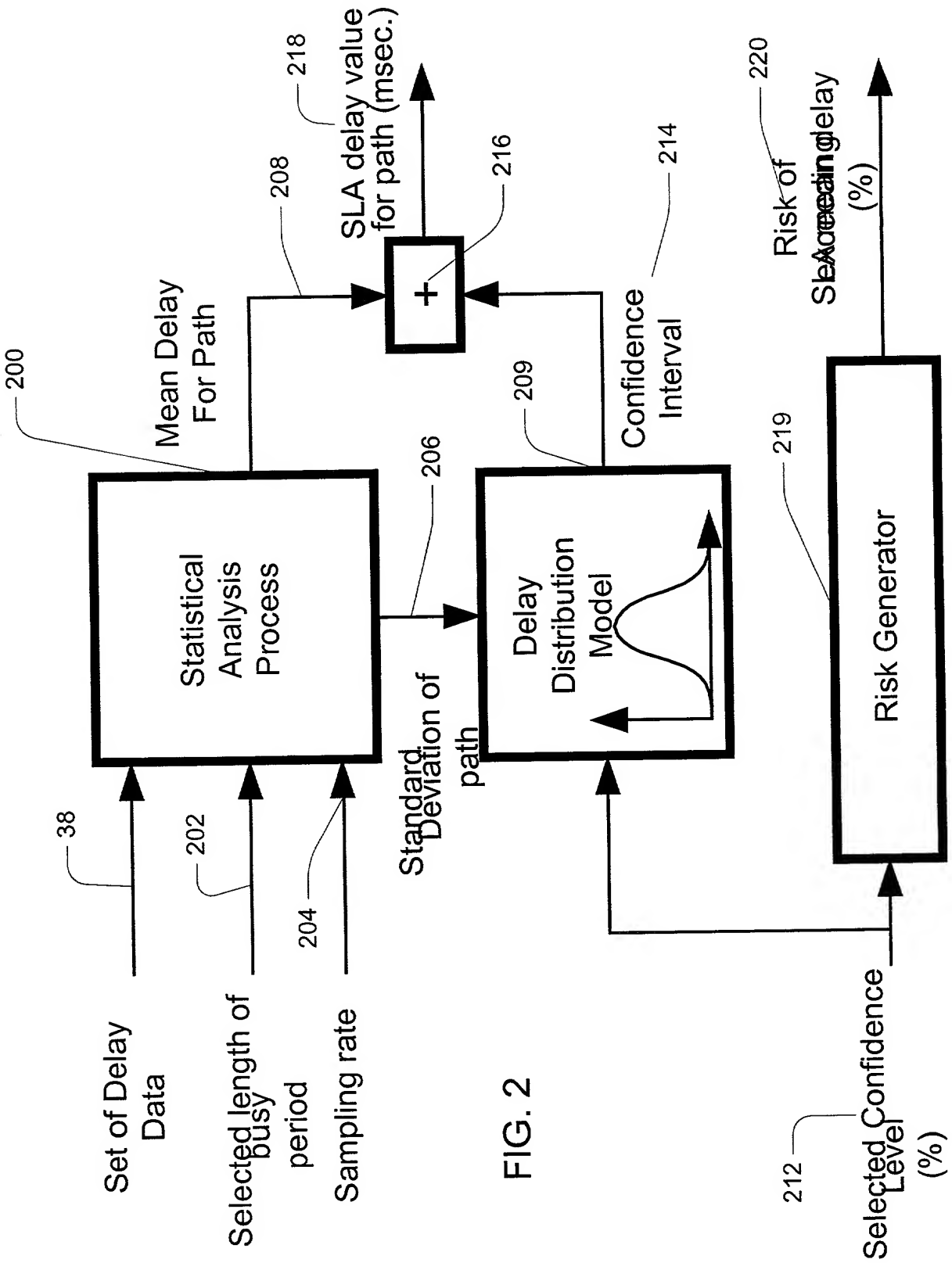
Set of Delay Data
38
Selected length of busy period
202
Sampling rate
204
Statistical Analysis Process
200
Mean Delay For Path
208
Standard Deviation of path
206
Delay Distribution Model
209
Confidence Interval
214
+
216
SLA delay value for path (msec.)
218
Risk Generator
219
Risk of SLA exceeding delay (%)
220
Selected Confidence Level (%)
212

FIG. 2

FOBOFF "9085E00F

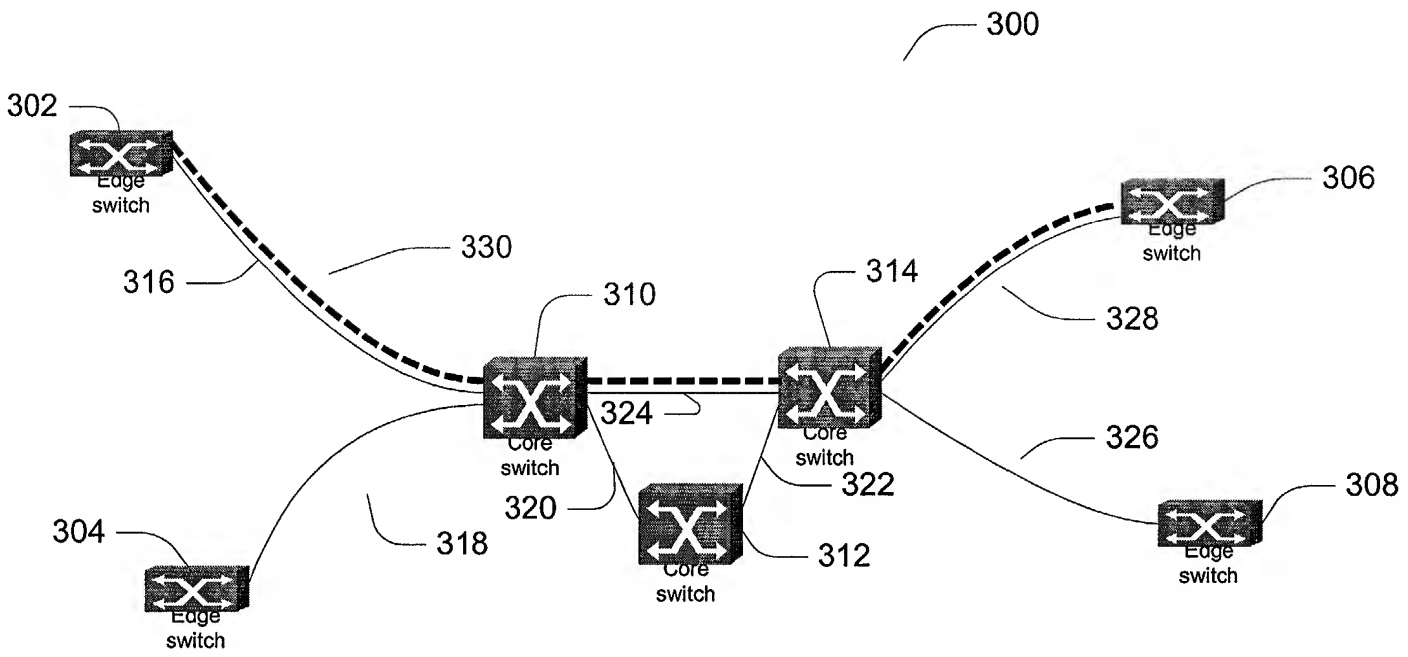

FIG. 3

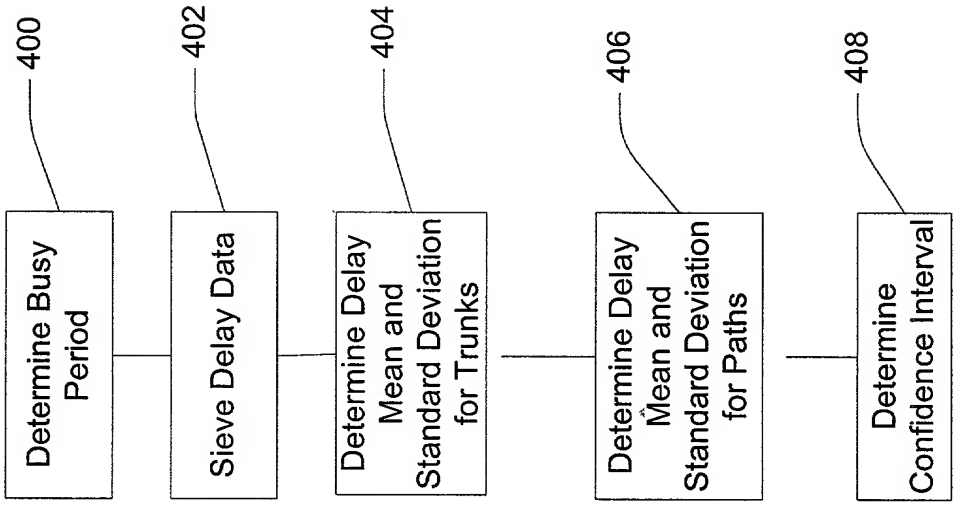
400
Determine Busy Period
402
Sieve Delay Data
404
Determine Delay Mean and Standard Deviation for Trunks
406
Determine Delay Mean and Standard Deviation for Paths
408
Determine Confidence Interval

FIG. 4

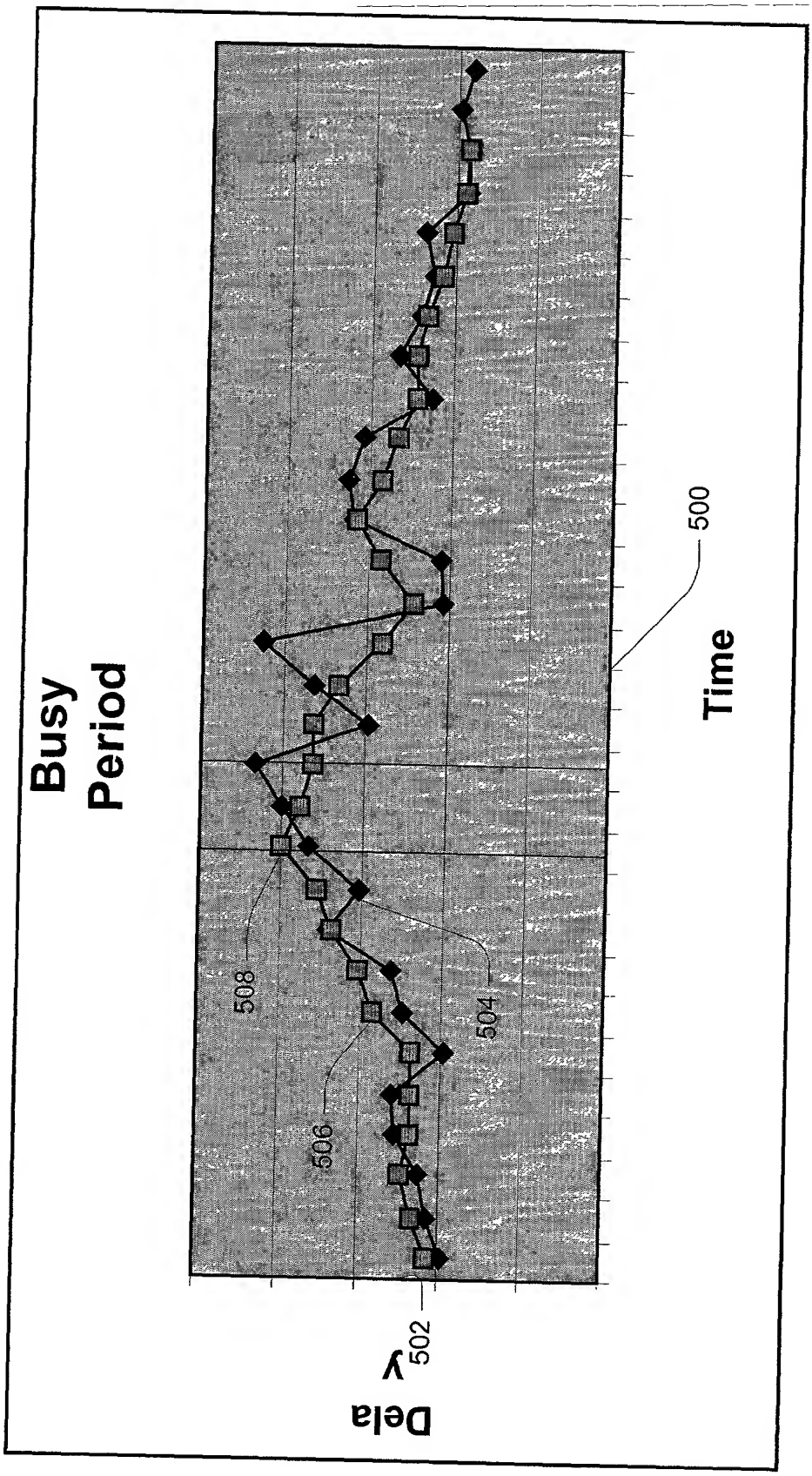

FIG. 5

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600

```
Start
For i = 1 To m scan paths                                          602

      Ai = 0  /* Summed delay */
      Bi = 0  / *Maximum Delay /                                   604
      Di = 0  /* Average Delay During Busy Period  */              606
      kmax = 0 /* Ordinal Value of Front of Busy Period */
                                                                   608
                                                  610
For k = 1 To [(24 * 3600)/ δ] - (ω * Ψ)
      For j =  1 To n
                                                  612
            For h = k To [k - 1+(ω * Ψ)]
                  Ai = Aij + Ai                                614
            Next h
      Next j
      If Bi < Ai Then

            Bi = Ai
            Kmax = k

      End If                                                       616

Next k

      Di = ⌈{[Bi/(ω * Ψ * j)]}⌉
Next I
End
```

FIG. 6

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Start

$D_{ij} = 0$ *Initialize average busy-hour delay. for trunk*

$S_{ij} = 0$ *Initialize Standard Deviation of Path i, Hop j*

For i = 1 To m *scan paths* — 700

For j = 1 To n *hop number* — 702

For k = K_i To $(K_i + \omega * \Psi)$ *Start at front of busy period* — 704

$D_{ij} = (D_{ij} + A_{ijk})/(\omega * \Psi)$ *Compute average value for busy period* — 706

Next k

For k = K_i To $[K_i + (\omega * \Psi)]$ *Start at front of busy period* — 708

$S_{ij} = S_{ij} + (D_{ij} - A_{ijk})^2$ — 710

Next k

$$S_{ij} = \text{SQRT}\left[\frac{S_{ij}}{(\omega * \Psi) - 1}\right]$$ — 712

Next j

Next i

End

FIG. 7

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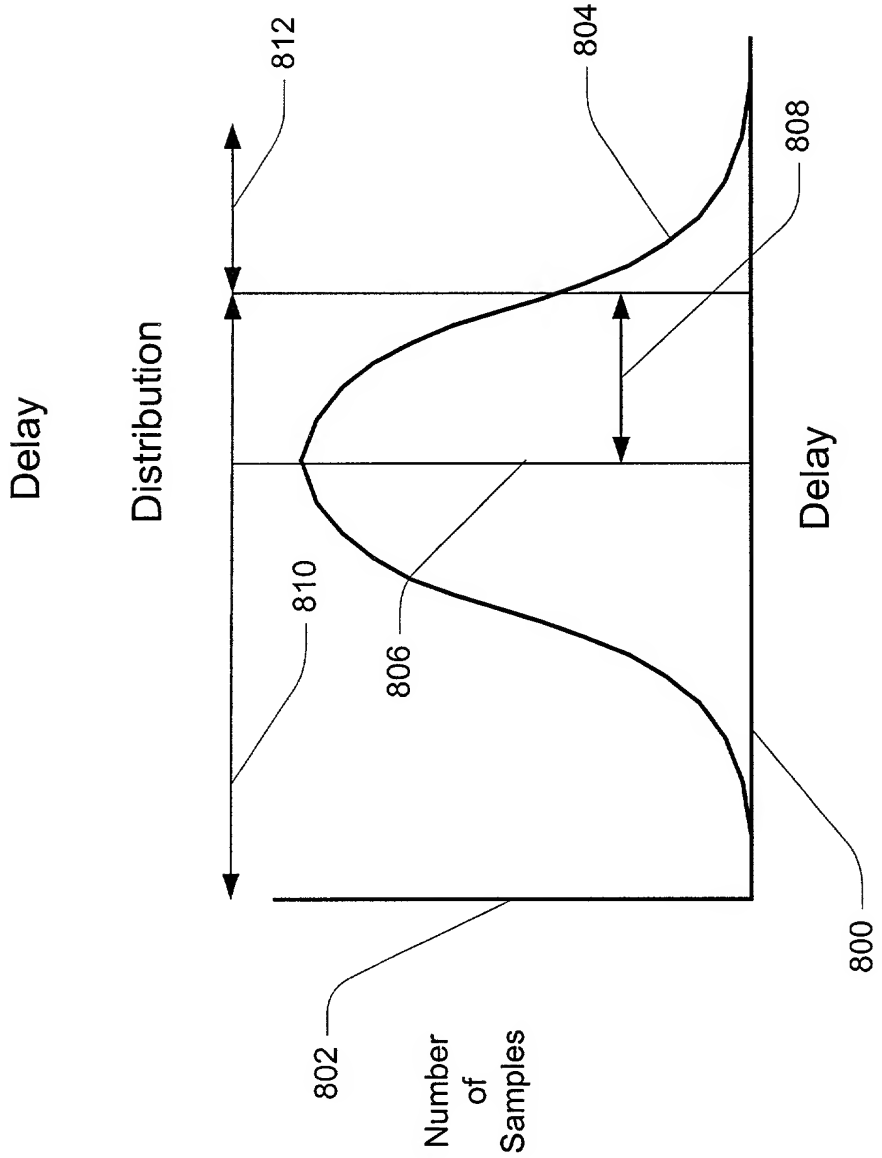
812
804
808
Delay
Distribution
Delay
810
806
802
Number of Samples
800

FIG. 8

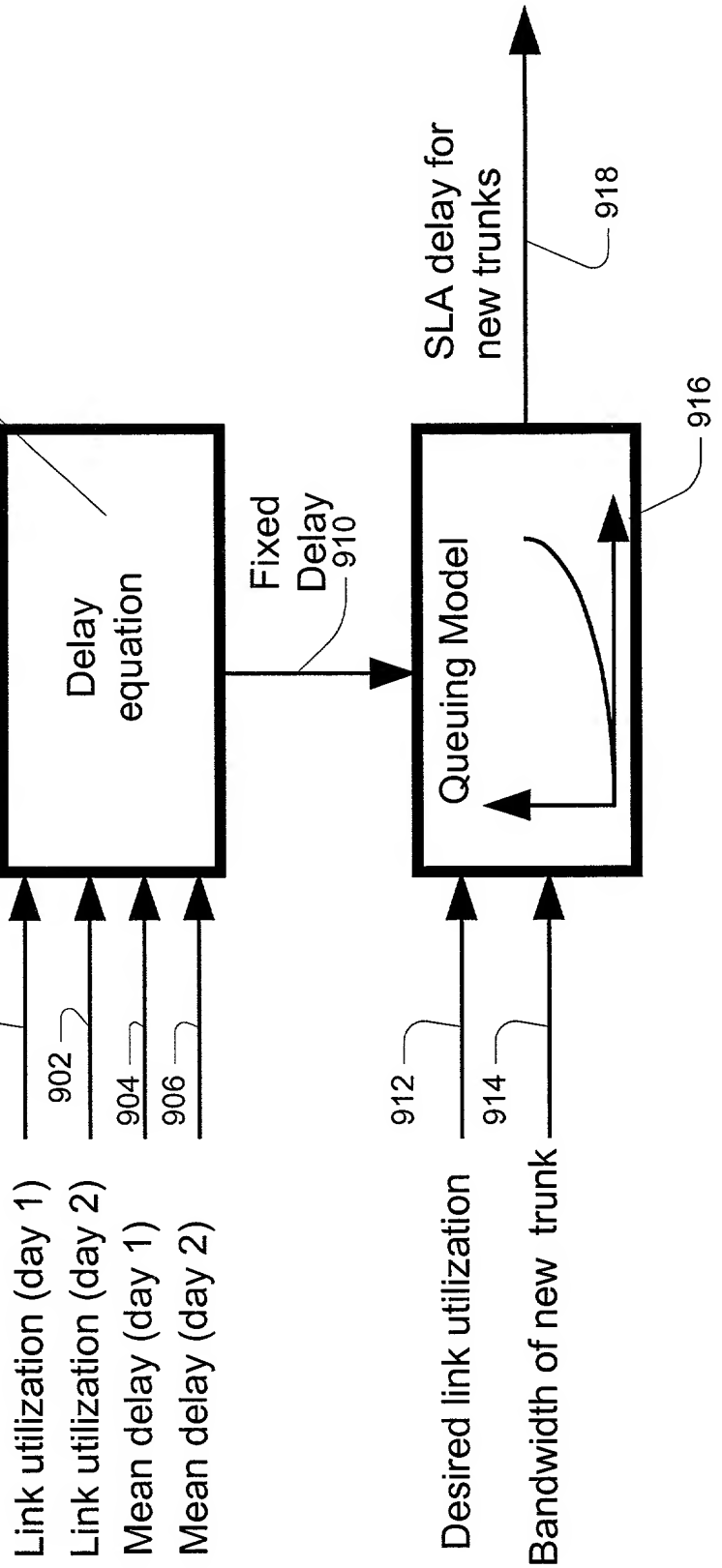
908
Delay equation
Fixed Delay 910
Queuing Model
916
SLA delay for new trunks
918
900
902
904
906
912
914
Link utilization (day 1)
Link utilization (day 2)
Mean delay (day 1)
Mean delay (day 2)
Desired link utilization
Bandwidth of new trunk

FIG. 9

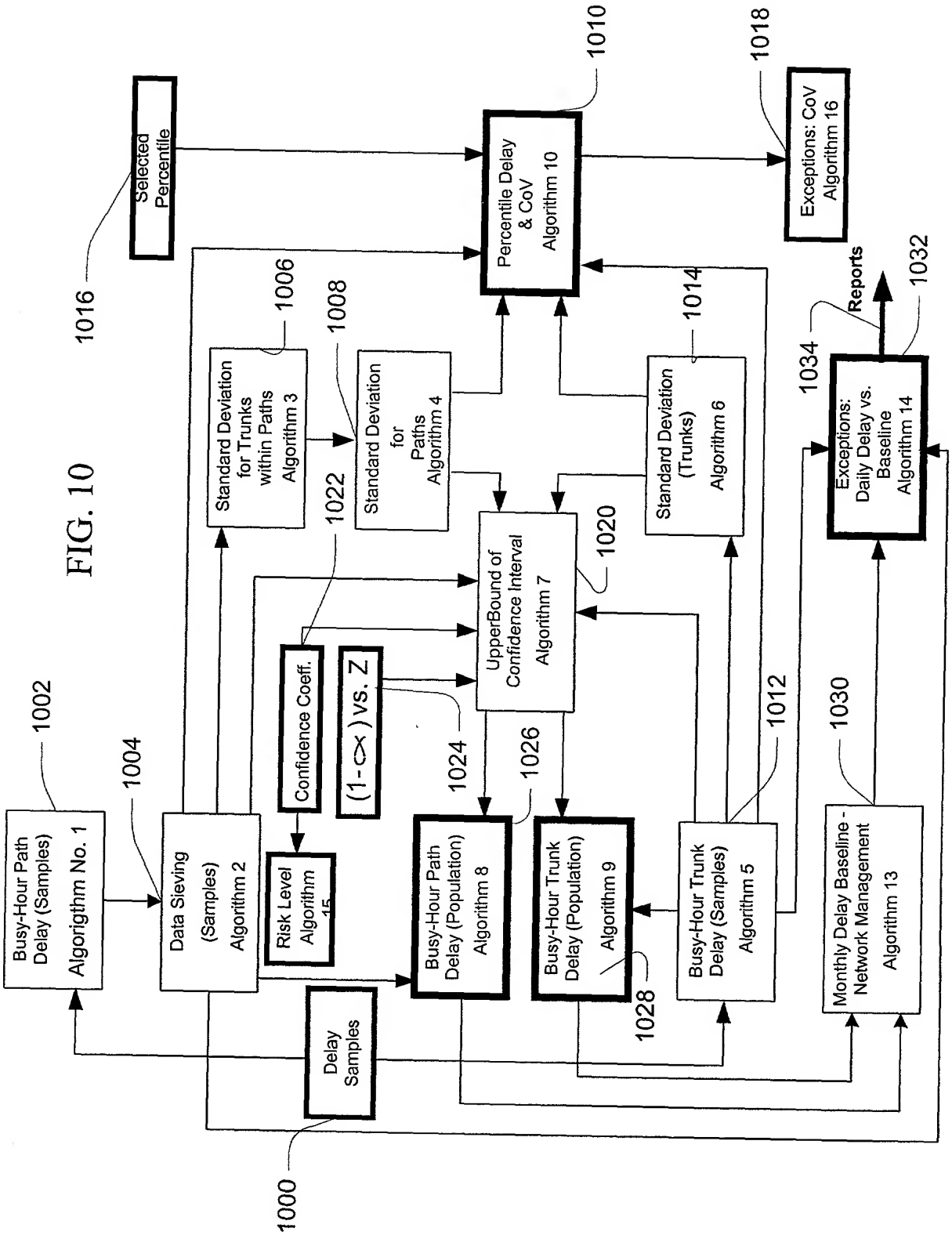
Busy-Hour Path Delay (Samples) Algorigthm No. 1
1002
Data Sieving (Samples) Algorithm 2
1004
Standard Deviation for Trunks within Paths Algorithm 3
1006
Standard Deviation for Paths Algorithm 4
1008
Selected Percentile
1016
Percentile Delay & CoV Algorithm 10
1010
Exceptions: CoV Algorithm 16
1018
Standard Deviation (Trunks) Algorithm 6
1014
Confidence Coeff.
1022
(1-α) vs. Z
UpperBound of Confidence Interval Algorithm 7
1020
Risk Level Algorithm 15
Busy-Hour Path Delay (Population) Algorithm 8
1024
1026
Busy-Hour Trunk Delay (Population) Algorithm 9
1028
Busy-Hour Trunk Delay (Samples) Algorithm 5
1012
Exceptions: Daily Delay vs. Baseline Algorithm 14
1034
Reports
1032
Monthly Delay Baseline - Network Management Algorithm 13
1030
Delay Samples
1000

FIG. 10

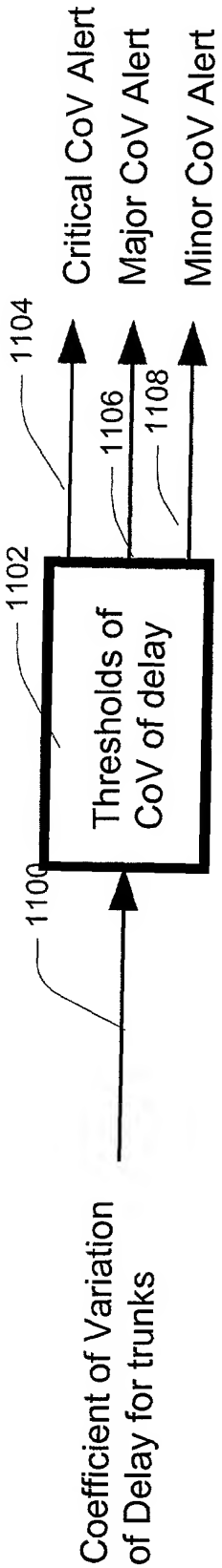
Coefficient of Variation of Delay for trunks
1100
Thresholds of CoV of delay
1102
1104
1106
1108
Critical CoV Alert
Major CoV Alert
Minor CoV Alert

FIG. 11

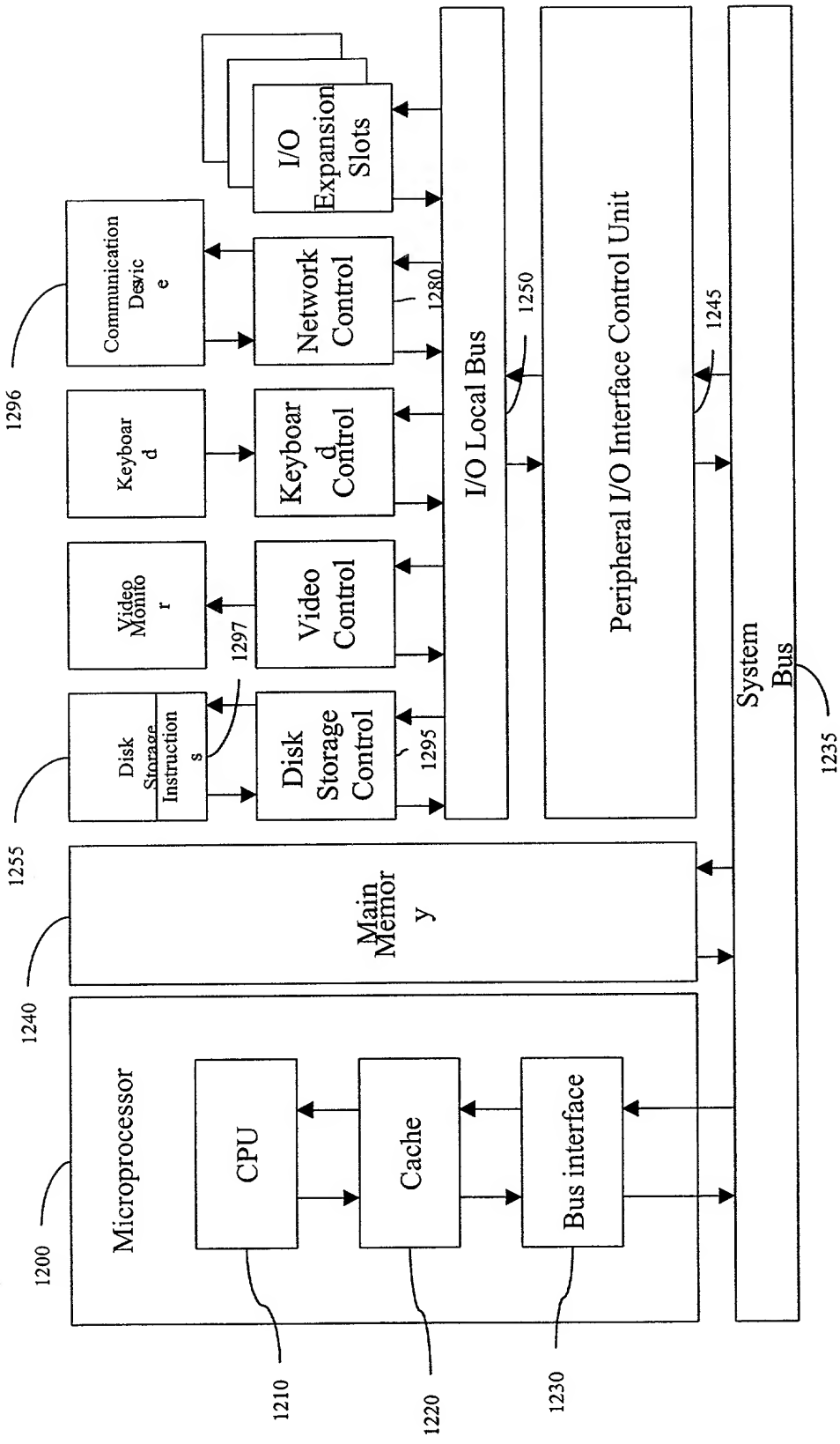
Microprocessor
CPU
Cache
Bus interface
Main Memory
Disk Storage Instructions
Disk Storage Control
Video Monitor
Video Control
Keyboard
Keyboard Control
Communication Device
Network Control
I/O Expansion Slots
I/O Local Bus
Peripheral I/O Interface Control Unit
System Bus
1200
1210
1220
1230
1240
1255
1295
1297
1296
1280
1250
1245
1235

FIG. 12